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TRENDS IN ENGINEERING EDUCATION[1]

By Professor DUGALD C. JACKSON

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

1. INTRODUCTION

ALAN SEEGER started his most famous poem with the lines:

> I have a rendezvous with death
> At some disputed barricade,
> When Spring comes back with rustling shade
> And apple blossoms fill the air;
> I have a rendezvous with death
> When Spring brings back blue days and fair.

We well may think of those words as we contemplate the state of engineering and its past and present relation to civilization. The rendezvous calling to us as engineers and teachers differs from Alan Seeger's. That was a rendezvous with death, but not with failure. In our calling of engineering education, we have a choice of a rendezvous with sterility and failure, or a rendezvous with progress and achievement which are helpful to society and associated with service to our groups of students. We who are in engineering education, and also all who are engineers, have been and are being sharply criticized for the outcomes of our labors; but it is to be remembered that much which is talked and written about education in its various levels and orders, including engineering education, and much which is talked and written about engineering technology is shimmering mirage instead of true substance. The fact is before us and is a background for what I have to say, but I can not elaborate upon this here.

[1] Address at annual dinner of the Middle Atlantic Section of the Society for the Promotion of Engineering Education, May 4, 1940.

Benjamin Franklin is credited with saying that prose writing should be smooth, clear and short.

The fact that constructive progress in engineering education is now stirring is demonstrated by such affairs as the admirable mutual relations arising from the activity of the Committee on Engineering Schools set up by the Engineers' Council for Professional Development, with which this society is so intimately associated; and also by such reports as that of our Committee on Instruction in English in the Engineering Colleges and of our Committee on Aims and Scope of Engineering Curricula, both of which reports were recently published. We may well wish that the latter committee had found it possible to take time to expound more fully the experience and evidence which established the underlying reasons for their beliefs and conclusions, for we know that the course of progress in erecting such a structure begins with examination of data or specimens and their statistical classification, as in the development of the various sciences. However, this report tells us that "engineering education rests on a foundation of science, of humanities, and of sound relationships rather than on the practical techniques of particular occupations or industries"; and it gives a summary of objectives which deserves to be read and pondered over.

I will here deal only with major influences. Details are treated in such Society for the Promotion of Engineering Education committee reports as have just been referred to, and in the special report prepared on behalf of the Committee on Engineering Schools of the Engineers' Council for Professional Development, entitled "Report on Status and Trends of Engineering Education in the United States." This report is long, but it is intended for personal study and annotation—for which reason it has no formal index. In what follows, I will try to be exact because philosophical discussion often takes the character of bartering misty thinking among the debaters.

As long ago as 1893, Professor R. H. Thurston said in a contribution to the *Proceedings* of this society; "Upon the thorough education of our engineers depends very largely the future progress of this nation." Quite recently, Dr. W. S. Learned, of the Carnegie Foundation, has expressed his opinion as follows: "I know of nothing more hopeful for society than to combine a good engineering education with a sound philosophy." Each of these pertinent sayings infers that we desire progress. But, what is "progress"? In reflecting over this some time ago, I formulated a definition—"Progress involves the development and satisfaction of wants which are of a higher order." That definition leaves us still drifting. What are "wants of a higher order"? Truly, we must look sharply to be sure that our rendezvous is with progress and achievement and not with sterility.

2. Relation of Engineering to Civilization

"To live, the early Egyptians had to tame the jungle, drain, ditch and irrigate their fields. This required not only technical advances, but a high degree of social discipline. But out of it came a pioneer civilization of the world." Thus speaks a recent analytical history of the world. The same statement of conditions may be made for the probably equally early settlements of the valleys of the Tigris and Euphrates and other favorable areas. Note that, to live, these primitive peoples near the dawn of written history had to "drain, ditch and irrigate." That is, it was on crude engineering that these primitive peoples relied, associated with a degree of "social discipline"; and on that combination was built their early civilization. Note, also, that the "social discipline" already was in the world among prehistoric people in Europe, who developed a crude engineering which enabled them to construct and live successfully in communities. The dwellers' relations in each community compelled the gradual formulation of codes of ethics and rules of morality. Professor George F. Moore, distinguished scholar and authority on the history of religion, has said: "Civilization develops only where considerable numbers of men work together for common ends. Such unity is brought about, not so much by community of bare ideas, as by community of the feelings by which ideas are emotionalized and become beliefs and motives." He farther points out that political, geographical and climatic, and economic features are not to be ignored because they may explain peculiarities of particular civilizations, or their rise or fall—but they "do not account for civilization itself."

Thus the seeds of civilization were sown, and engineering aided in that sowing. Engineering and civilization ever since have marched together—each encouraging and influencing the other. As the experience of man over the untold thousands of years enlarged his intelligence, he improved his engineering and his civilization profited by it. Communication became more readily accomplished between man and man, between community and community, and even between tribe and tribe; so that practices which added to safety, convenience and comfort among one group became known and used among other groups even in distant places.

Cupidity (greed) and the lure of barbarous excitements seem to have been among the first intrinsic human qualities, and they still are intrinsic. The two influences—(1) engineering with its possibilities for providing health, comfort, convenience and opportunities for happiness and (2) the innate cupidity coupled with love of barbarous excitement—are antagonistic and have been so as far back as records go. Murder, arson, cruelty, corruption, immorality, slavery and brutal wars are dominant features of the records of all parts

of the world for which records remain. If there has been any change in the extent and repercussions of these horrid activities of man, I am willing to place my wager on their having become ameliorated (considering the world as a whole) century by century during the ages only a little.

Those who paint the bad state of present-day civilization compared with the periods long gone by are not scattering original thoughts. That same plaint has been heard for millennia of years; and if the retrogression has so continued through the years, our far ancestors must have been veritable angels—or else we now are in terrible case. I have discussed this at greater length in a small book entitled "Engineering's Part in the Development of Civilization," which is published by the American Society of Mechanical Engineers. This is a book intended to be read thoughtfully and reflected over for the purpose of getting a better understanding of where we stand as engineers, why we are here, and the what of future opportunities and responsibilities for engineering. However, not all the learned ancients were sure the world was retrograding—which also is true of some of our moderns.

I already have referred to the application of crude engineering in drainage and water distribution in the early settlements of the Valley of the Nile, the Valleys of the Tigris and Euphrates, and elsewhere, which enabled the several peoples to live under favorable conditions for their early times and to develop notable civilizations of their particular types. Most of those developments lost their status as a consequence of external and internal wars. The peoples possessing, for their times, highly developed arts and technology fell before cruder and more hardy hordes. Why this should be is not clear. Many questions stand unanswered. Did the more leisurely life of art, agriculture and technology cause in the civilized groups a touch of abstraction and indifference and a softness which made them incompetent for self-protection against the invasions of barbarians? Was the overthrow in all cases the result of war? If not, what were the causes underlying the downfall where barbarian war was not the cause?

Especially, was loss of engineering skills and techniques the primary cause of the downfall of Persian and Arabian civilizations; and of the Arabs in North Africa toward and after the middle of the Christian Era? What of the Mayans and certain of the ancient tribes of the South American Andes? Were their engineering skills (great as they were for their times) inadequate to enable them to cope with changing climates or other natural cataclysms, which left only the alternatives of adaptation or extinction? If we had the answer to all these and some like questions, then we might correctly appraise our present state.

It seems to be a determined historical fact that small parcels of land alone, farmed by individual families, can only support such families in relative poverty. In the same geographical locations, large land-owners can become individually wealthy through purely agricultural interests, but only by the utilization of human slavery or the exploitation of driven hired-workers. The introduction of local mechanical industries and general commerce changes all that. The cheapening of needed industrial products and the increasing local demand for foodstuffs and for raw materials for the industries make it possible for the small land-owners of intelligence to farm with moderate profit and improve their level of living, and also possible for the large land-owners to maintain moderate wealth while subscribing to reasonable conditions of work and pay for their workers.

Much of the apparent failure to learn by historical precedents is due to the fact that the world is new in its relation to the minds of each generation; and generations have an unconscious wish to find the way by original experience through the processes of trial and error. It is in the nature of immature men to be wishful thinkers. The same fault is strengthened by the practice of historians in former generations to extol the glories of dynasties and of military victories, and say little about the lives of the masses of people and the social, economic and technological conditions surrounding them. Historical treatises therefore have provided no sufficient touchstone with which to test the effects on the life of the masses of peoples which have arisen from engineering inventions and engineering industries.

Let me emphasize the fact that engineering is the tie which bridges the chasm lying between the mathematical, physical and biological sciences as one abutment and the human phenomena of economics and sociology, with their psychological qualities, and which jointly constitute political economy, as the other abutment. As a field of learning or of action, political economy is all bound up with human aspirations and passions. It is difficult to spin out uniform and sound threads of thought in its field unless and until psychologists identify and define the fundamental elements in the mainsprings of man's thinking, and then discover the principal relationships between stimulus and response. Many of the misinterpretations of the relations of engineering with present-day civilization arise because so little is factually known regarding these psychological elements in man's thinking. It is also a fertile cause of misinterpretations that human incidents in history are not more fully and widely known.

Here is an illustration that man's innate processes of thinking and acting change very slowly: What better description of the qualities exhibited in the ravishing of Austria, Czecho-Slovakia, Poland, the occupation of

Denmark and the attempt on Norway than the following: ". . . that bitter and hasty nation, which will march through the breadth of the land, to possess the dwelling places that are not theirs. They are terrible and dreadful: . . . They shall come all for violence: . . ." This might well have been written in the year 1940, but in fact, it comes from the Old Testament book of Habakkuk, which is supposed to have originated about 2,400 years ago, and the nation referred to is definitely named as the Chaldean. The quotation is a transcript from the King James translation, which was first published over three hundred years ago. There is no suggestion or inference in the trenchant charge against "that bitter and hasty nation" that it was enabled to carry on its violent career because the development of technology had outrun utility, as the charge is made against us to-day.[2] It is obvious that man (both individually and collectively) has not yet become convinced that a life of honesty and fair dealing is more profitable in the long run than the reverse. An apparent profit of the moment still looms larger in most human eyes than the dribbling profits of the long run. Here is a great field of education crying for the attention of sociologists and philosophers.

As badly off as we may be in this country compared with abstract possibilities, we nevertheless have reason to hold up our chins. I will quote a bit from one who should know, Louis Adamic, who himself came to us as an immigrant and who now has turned himself to the effort to awaken in us an understanding of our faults and to stimulate a more fully organized mutual effort to overcome them. Referring to the great proportion of our population who were immigrants or are in descent from immigrants, he says that the great majority of them "are humble folk, workers and farmers who skate on thin ice along the margins of our erratic economy. Some are or were on relief, though not nearly so many as generally imagined . . . . There is no doubt, though, that most of them *are economically better off here than they would have been in the old countries*" (italics mine).

It has been asserted customarily that our relatively high level of living for all citizens is due to the wonderful supplies of natural resources to which the people of this nation fell heir. But there is a catch in that. Those natural resources would not have raised our people to their relatively high level of living except for the steady application of a high level of intelligently directed industry associated with the greatest development of engineering technology through scientific discovery and invention which the world has ever experienced. We can continue in the same route and maintain ourselves on a rising level and to an improved civilization through the steady scrutiny and improvement of our engineering by farther exertions in the field of scientific discovery and invention; and with that rests our salvation as a people. Relatively, our ethical and altruistic status has been good, but in absolute measure it has much progress to make.

Before turning to our part as engineers in the great problem of our responsibility previously referred to, I will speak of one other factor. Some 2,000 years ago there was put before the world with astonishing boldness, vigor and vitality the ethical tenet of the brotherhood of man, in the preachings of Jesus Christ which established the doctrines of the Christian religion. The doctrine of the brotherhood of man stands to the front in no other world-religion. It has been thought of as a guide in the western world, with its full adoption to be expectantly worked for. We now know that the expectation has been over-optimistic, for the tenet has not secured a firm hold among certain of the peoples of the world even in the Occident. However, the vitality of the doctrine is proved and its qualities impose an additional responsibility on the followers of engineering—and especially on those of us who live in America, where our substantial freedom of thought and effort is established.

Let us now think of what engineering education is—and why it is. Mathematics, chemistry, physics are largely analytical; political economy is still largely in the classification stage of development; engineering (including invention) is synthetic in the ultimate, because it builds up by transfusion the scientific processes into human welfare. Engineering and civilization originated in an association with human welfare, and both continue to exist because of this continued relation with such welfare. We must accept the fact or we are not fully qualified engineers. As the poet Horace says, "The grape's in the raisin." We can not dodge the fact.

Engineering education has for its purpose the provision for its students of knowledge and wisdom in certain fields. This requires a reasonably successful effort on the part of the students to become filled with a knowledge of facts of nature and their relationships, and with facts regarding man and his relationships, and to become wise in adapting the phenomena of nature to the service of man. Thus stated, the total field is seen to be illimitable in its scope, and individual students choose defined portions in accordance with their tastes. In the early days of formal engineering education, the situation was relatively simple, because so little of the total scope of engineering was as yet drawn into an intellectual discipline or a series of such disciplines. Most of us then expected to deal with structures or means of transportation, or perhaps both, and the relations of these to public welfare were quite definite. But we now have a series of disciplines

[2] The cynically brutal violation of Belgium and Holland has occurred since the date of this address. The analogy with the barbarous Chaldeans is not lessened.

amongst which each student chooses that which he prefers to follow in a major way; the activity in scientific discovery and invention has resulted in a vast scope of engineering industries, for which the relations to human welfare are no longer definite; and study of these relations has become a compelling part of engineering education.

It is here proper to introduce the reminder that stale minds do not come to greatness in engineering any more than they do in poetry, music or art; and the engineering teacher who is commonplace in his teaching of engineering topics is merely opening to his students the entrance gate to the broad highway of mediocrity. Engineering is of the intellect and engineering education in its higher development must be an intellectual education—but cultivation of the imagination, associated with the quality of "carrying through" projects concretely, is a *sine qua non*. The inventor-genius of American engineers has held a great part in the development of a high level of living in the country and it continues in its good effect. This should not be forgotten in planning engineering education. Here is a frontier which can not be pressed back or exhausted while American intelligence is maintained, however actively the exploitation of the frontier's figurative forests and the turning of its figurative sods are carried on.

3. How We Are Meeting Our Responsibilities to Society

From the foregoing, it is easy to see that we are resting in a situation where the engineering schools have special responsibilities because education is not a thing in itself but it is, if properly visualized, for each individual a preparation for living in the setting into which his ambitions lead him. That means that engineering education must be aimed at a sound scientific foundation for engineering, accompanied by an adequate understanding of the influence which progress in engineering exerts on the life of each student and his fellow citizens. We have a nation in which it is intended that men may independently enterprise, build and produce to their own benefit, but with due consideration to the welfare of their fellow citizens and their fellowmen throughout the world. For this environment the engineer must be strong in his character; and for the purpose he must not only have knowledge of nature's phenomena and the characteristics of men, which lie at the heart of engineering, but he must observe acutely, think accurately, express his thoughts both honorably and cogently, and understand and interpret the truth or untruth in the expressed thoughts of others. In the early days of engineering education, the technical aspects were mainly thought of—and the engineer who came to influential place in the profession was compelled to learn the rest mostly by experience. Happily, the trend of engineering education during the past twenty-five years has brought these latter aspects into the realm of the formal educational processes, while the exact details of technical practice have been left more largely to the school of experience. Thus we have recognized a responsibility to society, the depth of which has affected our professional attitude.

If we add to the foregoing a sense of wise tolerance for conflicting views which are sincerely expressed and not logically controvertible, we have reached the scope of a truly liberal education. It is one which responds to the definition of the poet Milton (given in his "Essay on Education") that a complete education is one which fits a man to perform "justly, skillfully and magnanimously" within his sphere. The importance in the affairs of society of this last-named feature of tolerant consideration of sincerely expressed views of others has of recent years, it seems to me, become more strongly impressed in all scientific circles, including engineering; but we can serviceably give more thought to its emphasis in engineering education. It very likely is in the selection and training of teachers for important places in engineering education in which this emphasis should primarily be placed. Of the young teachers we may well say that when the tree is of good root, the fruit will be good. But, to secure the best, the tree must be properly cultivated and sprayed.

However, the responsibility of engineers to society can not be fully met by teachers alone. As the poet Horace said, in effect, of responsibility for hospitality, "No matter how good your wines may be, you must also be sure that you use a high grade of oil on the fish"; and we must get our students to reflect on the economic and social implications of engineering, without lessening their mastery of the scientific relations. The tendency for solving this problem in engineering education is to put more responsibility on the individual students for specific and general study within their chosen fields—with sympathetic direction and supervision by members of the teaching staff. This puts, within limits of a prescribed scope, the degree of responsibility on the students for their self-education and enables each one to go as far within the particular scope as he can and will. This may sound to some ears like an exhibition of unfair partiality, but we must remember that the oak and the palm require different qualities of nurture in order that each may grow to its greatest prosperity and fruitfulness; and that each one, though different from the other, is of value in its individual degree.

Examinations determine whether each student has achieved at least as much as some assumed minimum. Those who can not achieve the minimum are not altogether without merit; and fair play requires that they

should be aided in the effort to enter a more appropriate channel. A few engineering schools have awakened to this fact and are utilizing vocational advisory measures for this and other purposes. Common sense consists in seeing things as they are—and this attitude responds to the sentiment of fair play. The elimination of the shallow-minded from among the pursuers of engineering education is an economy; but, principally, it is desirable for the avoidance of over-cultivation which causes mental sterility like the sterility of sub-marginal land which has become exhausted from over-cultivation. We can not afford to be unsympathetic or snobbish in the engineering schools. Our field includes applications to general welfare of the teaching of science and experience; and we may remember that a deep fault of some peoples has arisen from the attitude of powerful educated groups who have sneered at the weakness of the masses and opposed their rise. Our attitude ought to be one of sympathetic aid toward directing each individual into an environment for which he is fitted. Engineers in practice must deal with tremendous numbers of people who are incompetent to substitute in their work, but whose own work is highly needful to the success of theirs.

Some educators argue that special sectioning for classes and special provisions for the more active-minded and sound-thinking students are objectionable because they do not comport with democracy. However, this is a false argument. In no society are all people alike, whether the society is democratic, aristocratic, totalitarian, communistic or what not in form. In a democracy all people should be established in equality of rights, but likeness in quality of mind and ambition is not to be had. The problem in democracy is to enable each individual to achieve to the extent of his ability the practical benefits for himself and the body politic. Intense regard for the very best accomplishment available in an individual is the touchstone for establishing a good reputation. As a consequence, special sectioning of classes in the engineering schools, according to the mental-speeds and abilities of the individual students, is truly democratic.

Moreover, it is just and right that engineering students should exert the effort for self-education, because the benefit accrues to them individually, as well as to society. If each one of us here will reflect on the status of those who are outstanding among his associates, I feel sure that he will become convinced that in most cases concentrated self-chosen study and keen observation of the consequences of experience are the foundation of the elevated achievements. Engineering students should learn in the engineering school, if they have not learned it before, that the moment one quits in the effort of self-education and demands to "be taught," one simultaneously turns one's back on one's individual progress in the profession; but that, as long as one studies and gains additionally the benefits of life and experience, one may expect the efforts to be rewarded.

Happily, these principles are gaining stronger hold among the engineering teachers. Conventional, pedantic and treadmill practices are losing fashion in the engineering schools, pre-digested text-books are not so widely popular as formerly, and the encouragement of independent student thought and effort is more in the style. Easing of the load of conventional class-hours of work assigned to the teachers is needed in many institutions; and advantage would be derived thereby for students and for the engineering profession—even though the result should be that fewer engineering details are dwelt upon by the curricula. A wider use of the exchange of professors among the engineering schools would be helpful in accelerating this reform, by broadening the bases of experience enjoyed by individual teachers.

Most of us here are engineers and teachers of engineering subjects. We thus are bound in two professions—engineering and pedagogy. Engineering is a research occupation which holds our hearts' interest, but we have come to appreciate the importance of sound pedagogical reasoning—or we ought not to hold our posts of teachers. We also have come to a lively appreciation of the importance in engineering curricula of the arts of expression (*i.e.*, the languages and drawing) and of political economy which comprises economics and sociology, because of the important part that the utilization of the former plays in every influential man's life, and the tremendous effect that engineering plays, and has played, in the economic life of the nation and the development of the national, social and political life. We also appreciate the desirability of acquaintance with recreational fields of the nature of music and art and literature.

As engineers, we are jealous of our mastery in our particular engineering topics and, as good teachers, we wish to teach and inspire within their boundaries; that is, on ground which we know best and in areas within which our inquiries may be most interesting to us and fruitful to the nation. We understand the importance to our students of becoming skilful in the arts of expression and qualified in knowledge within the field of political economy, and we ought to insist that only masters in those fields should be drawn upon to teach those tenets to our students. We ought not to desire to ourselves control the teaching of these subjects, because they are not of our mastery and the topics of our own mastery ought to hold us each individually bound.

In this we have been hesitant and have failed to lend full sympathy and encouragement to the teachers in these collateral fields. Indeed, these collateral departments often have been looked upon as ones having

nothing more substantial to offer in our educational setting than a rather thin criticism. As a matter of fact, it would be good for all concerned to invite them to prove their interest in solid contributions to education for fully rounded professions. This more sympathetic attitude by the engineering professors toward the collateral departments appears to me to be gradually expanding—but it is worth while to emphasize the lesson of hearty cooperation of all departments for general benefit and for the best interest of overlapping features of the work, remembering that cooperation connotes friendly concurrent effort by a multiple of individuals.

Respecting purely recreational topics, we all recognize that substituting evanescent material in an undergraduate curriculum in place of substantial basic studies is like substituting second-rate concrete in an edifice where only marble is appropriate. However, there are certain features needed to support our work, and happily it is common observation that students in the engineering schools that are located in large cities take general advantage of the excellent opportunities to hear fine music and see great art; and interest in their doing so is expressed often by members of the engineering faculties. It is my inference that the radio carries much good music to engineering students in engineering schools located in the lesser cities. Optional studies now are available for stimulating these interests and interest in literature as well as world interests.

And now I imagine that you are bursting with the question, Why should engineers be held responsible for guarding their work from diversion into paths which are harmful to civilization, while research scientists are not held responsible for making useful applications of their discoveries?

The statement of the question shows the answer. Engineering is the art of directing the forces of nature for the service of man—and any diversion to disservice is false. We may condone a cloistered attitude on the part of research scientists, although we may regret the withdrawal of able men from reflection on the duties of citizenship. But engineering is as deeply involved in the economic aspects that arise from it as it is in the scientific aspects from which it springs. As individuals we can not control the misuse of our works, but it is a duty of the engineering schools to impartially expound to their students the various economic and social influences that may arise from engineering. We need more clearly defined research into the serviceable and the disserviceable effects that may arise from engineering which springs out of scientific discovery and invention, so that the great populations of the world may better know how to avoid the disserviceable.

In the meantime, it rests with the engineering schools to put before their students the truism that untoward events arise out of human errors, angers, jealousies, vanities, selfishnesses and greeds; while fortunate events arise out of the developed sense of mutuality of interest among individuals and nations—which sense leads to platforms of generous fair dealing. Here is where we are now most deficient in our efforts. The problem of improvement is a difficult one, but I have seen such magnificent improvement in engineering education during the last half-century that I am filled with the optimistic belief that this problem ultimately will be solved.

OBITUARY

JOHN ELIOT WOLFF

THE death of Professor John E. Wolff brings to an end a close association and friendship of more than forty years which for the writer of this note has been a major influence in his scientific work. Our acquaintance began in 1895 when he called me to Harvard to help in the reorganization of the mineral collection of which he had recently been made curator. Wolff was conducting courses in petrography and mineralogy in a newly organized department closely associated with the department of geology. Instruction in mineralogy was within a few years placed in my hands, and Wolff devoted himself to petrography and optical mineralogy. His interest in the Mineralogical Museum grew with the years, and he gave a large portion of his time to its improvement. He added to it largely from his private means since it was not at that time endowed. He also provided instrumental equipment for the laboratories and equipped a chemical laboratory where he did quantitative work of great accuracy.

Wolff studied with Rosenbusch in Heidelberg in 1884–85 and was one of the first to teach in this country the then recently developed science of microscopical petrography. He was much in the field in his earlier years: with Shaler in Kentucky; with Pumpelly in the Transcontinental Survey for the Northern Pacific Railway; and as a geologist of the United States Geological Survey, working in western Massachusetts and northern New Jersey. His name appears as co-author with Pumpelly of the monograph describing the Hoosac Tunnel section through the Berkshires, he having done the optical petrography as well as much of the field work for that study.

He took part in the International Geological Congresses of 1900 in France; of 1906 in Mexico; of 1910

in Sweden; and of 1913 in Canada; and from all these trips he brought large and carefully selected collections of rocks for use in his teaching. The big hammers that he carried in order to secure fresh specimens were famous, and other members of these excursions gathered around him to share the results of his spoils.

While in Montana in 1883 on the N.P. Survey he visited the Crazy Mountain group and discovered the peculiar alkali rock-type to which Rosenbusch gave the name *theralite*. He revisited this mountain group twice, mapping and collecting additional specimens of its varied igneous rocks; and all the rest of his life was more or less devoted to the study of this material, his final report appearing in 1938 in the *Bulletin of the Geological Society of America*.

Professor Wolff's most important contribution to the development of the department at Harvard so long in his care was in securing the Holden endowment. Albert F. Holden, who graduated in 1888, was a very successful mining engineer. Early in his professional career he began to collect the minerals found in his mines and ultimately accumulated an important collection. Holden intended his minerals to go to Harvard and therefore kept in close touch with Wolff in order that his collection might supplement rather than duplicate the Harvard cabinet. When in 1913 Holden realized that his career was destined to come to an untimely end through an incurable disease, he conferred with Wolff as to the form and wording of the munificent bequest with which he had determined to endow the Harvard Mineralogical Museum. He died before the end of the year, and his minerals came at once to the university. Professor Wolff, during the next few years, spent all his free time incorporating into the exhibition cases the more striking specimens from Holden's collection.

It was not until eight years after Holden's death that the trustees of his estate were able to turn over to the university the endowment fund. When it had been received in 1922, Wolff decided that the event marked a proper termination of his active service for the museum and the department of mineralogy and petrography. He therefore retired at commencement, 1923, and left to the writer the acceptable task of carrying out the intent of Mr. Holden, to raise the Harvard Mineralogical Museum to an equality with the best, a task made possible by the generous funds provided. Wolff also gave his own considerable estate, subject to a life annuity, to the university in the form of the John E. and Philip Wolff Fund, the income of which, after his death, was to be devoted to the growth and use of the collection to which he had devoted so large a part of his life.

Immediately upon his retirement Wolff sold his Brookline house and removed to Pasadena, California. His letters after settling in the comfortable new home which he established there were full of delighted appreciation of his freedom from routine cares and of the comfort of a mild climate. Always an enthusiastic motorist, he provided himself with a car especially equipped for travel in the desert, and Death Valley became his familiar touring ground during the winter months. He made a special study of the tragic story of the Manley party, first to cross that famous depression, and published a pamphlet on their probable route. It was often his custom to drive there, alone or with a companion, camping by preference near a lonely farm high on the Panamint Range.

Knowing the desert so well from his long experience, it seems unfortunate that he should have set out alone, at his advanced age of 83, in the midst of the summer heat, into the Mojave Desert upon what proved to be his last trip. He was found in his car, which was hopelessly sanded, having died apparently from heat exhaustion after using all his resources to extricate his machine from the desert sands.

Wolff was of a retiring nature, and it was not easy to penetrate his reserve. Those who had lived with him in camp say that there he relaxed and revealed his intense enjoyment of life in the open. Gentle and kindly he was, and his purse was always open to those who needed aid. He was a musician, and after he ceased to be able to play the piano his Victrola became his greatest solace. His house at Pasadena was full of the latest optical and microscopical equipment, which he used up to the time of his death. This is not the place to tell of the domestic afflictions which left him a lonely soul. My last visit with him six months since left me with the sad assurance that he was failing rapidly, and I can not grieve that he died as he did in the open desert wastes which he had grown to love so well.

CHARLES PALACHE

SCIENTIFIC EVENTS

THE FISH AND WILDLIFE SERVICE

PURSUANT to the President's Reorganization Plan No. III, and House Joint Resolution 551, the Bureau of Fisheries and the Bureau of Biological Survey was on June 30 consolidated into a new bureau to be known as the Fish and Wildlife Service. It is believed that this consolidation will provide many advantages to both bureaus, and that it is further evidence of the interest of the Administration in the conservation of fish and wildlife.

A statement made by Charles E. Jackson, assistant director of the Fish and Wildlife Service, is published in *The Fisheries Service Bulletin*. It reads in part:

Within the span of a few months we have twice been swept into the stream of progress by the President's reorganization plans. Each move has been in the interest of a better program of conservation of national resources, and efficiency of operation in implementing that program. In July, 1939, placed administratively under the guidance of the United States Department of the Interior, we went on to a fuller opportunity for development. With the merging of our forces and those of the Biological Survey, we should find even greater scope for our activities, more ease of movement and better hope for expansion of our services to the country.

The following is a typical example of the many advantages to be gained by the integration of the two bureaus: Supplementing the "91-billion-acre water farm," upon which it has been our task to guide aquicultural activities for the past 7 decades, will be an additional 14 million acres of federally protected wildlife refuge land. A vast portion of this land embraces both fresh- and salt-water areas wherein we may carry out necessary experiments in the conservation of aquatic life. There also are many favorable streams within these areas which may be restocked with fish; thus creating additional recreational areas for sport fishermen. For the first time in our history we shall have fish, as well as game, refuges—a seven-league-boot step in the direction of fishery conservation.

The President's reorganization plans have brought about a renaissance of the bureau in which all our efforts will be augmented by those of a staunch ally whose broader purposes have, like ours, been useful conservation of our country's natural resources.

REPORT OF THE SUB-COMMITTEE OF THE AMERICAN INSTITUTE OF CHEMISTS ON LICENSING OF CHEMISTS IN NEW YORK STATE

A SUB-COMMITTEE of the American Institute of Chemists on the licensing of chemists in New York State has made public its report. The committee consists of Foster D. Snell, *chairman,* Dr. R. E. Kirk and Dr. Maximilian Toch. This committee started the year 1939–40 with a bill which had been drafted the previous year.

The following is a summary of the report:

The bill was introduced by Senator Esquirol and in the House by another representative, in neither case under the direct sponsorship of The American Institute of Chemists. It was therefore printed on February 7, 1940, as Senate Bill 1111, and at some similar date as a corresponding House bill.

A conference was held by your chairman and Dr. Maximilian Toch with Governor Lehman in regard to this bill. This could be summarized simply to the effect that Governor Lehman stated that he would not sign such a bill even though it were passed by the legislature unless he were advised by the regents that it had their approval.

On February 24 a conference was held with Dr. Milton E. Loomis, associate commissioner for higher education. The summary of some two hours' conversation can be very brief. The bill as drafted would have the opposition of Dr. Loomis, who is in responsible charge of administration of such licensing acts. While he could not, of course, express the opinion of the regents, a definite inference was obtained that the regents would also oppose the bill in the form in which it stood at that time. There grew out of the conference the suggestion that licensing of chemists be handled by permissive legislation parallel to the way in which certified public accountants are registered. A draft of a proposed act pursuant to this suggestion was prepared.

At this point, therefore, the chairman who had been conducting these negotiations personally called a meeting of the licensing committee and presented this proposal to them for action on March 19. The committee on licensure approved the proposed change. It was then presented to the council at a subsequent meeting on the same day and also had the approval of the National Council.

The plan of the future schedule of the bill is as follows. It is expected that the present draft will be carefully gone over for revision by members of your committee during the summer. Fairly early in the fall it should be presented in draft form to Dr. Loomis and the members of the Board of Regents for consideration. As soon as the election is over and before the legislature convenes, it should be presented to the chairman of the Committee on Education in the Senate and in the House for their consideration. It is hoped that it can be arranged that these chairmen will present it as their bill to the 1941 legislature which convenes immediately after the new year. Provided it has their blessing and provided there is no serious opposition, it should pass the 1941 legislature.

The committee has cooperated very closely with Dr. Charles L. Parsons, secretary of the American Chemical Society, in all the above matters in the belief that it was only by cooperation rather than competitive effort that substantial and suitable accomplishment could ensue.

THE COLLEGE OF ENGINEERING OF CORNELL UNIVERSITY AND AMERICAN INDUSTRY

A PROGRAM of cooperation with American industry to train promising young employees as engineers has been announced by Dean S. C. Hollister, of the College of Engineering of Cornell University. The plan will use part of the income from the $2,000,000 John McMullen Scholarship Fund to create John McMullen Industrial Scholarships for apprentices in industry selected by officers of the companies as men whose value would be increased by a college education in engineering. Industries have for many years provided funds for scholarships and fellowships at Cornell and other universities. This program reverses the usual procedure, since the university provides the funds for educating men chosen by industries.

Endorsement of the program has been given by numerous leaders of industry, following the successful experiment worked out with the General Electric Company during the past year. Last September two high-school graduates from the four-year G. E. apprentice training course were awarded McMullen Scholarships of $400 a year, paying full tuition during the four- or five-year courses they chose to pursue. Both have made excellent records in the College of Engineering.

The Board of Trustees has now authorized the award of four such scholarships each year, making an eventual total of at least sixteen. The number may be further increased. Scholarship-holders must be high-school graduates qualified to meet the regular entrance requirements of the college, must have served some time as workers in industry, preferably in a regular training course, and must be recommended by their employers as men of special ability whose careers would be helped by a college course in civil, electrical, mechanical or chemical engineering. It is contemplated that the McMullen Industrial scholars will return to the same organization by which they were previously employed.

In a statement made by Dean Hollister he says:

> The College of Engineering is glad to have such students because they have already demonstrated initiative and a talent for engineering. As men who have acquired skill in the mechanical techniques of industry, they have a practical point of view from which to approach engineering problems professionally. Furthermore, because of their maturity and their practical experience, they have a clearer idea of their own objectives and of the value and meaning of our technical courses. Officers of industrial concerns are glad to recommend their superior apprentices to us, because they know that four or five years of college training in engineering will make them more effective employees. The program is especially beneficial to the students, because it gives them college training at a time when they are best able to assimilate it and use it to qualify for better positions in fields already chosen.

Applications for the four scholarships to be awarded in September are now being received by the college. This new use of the John McMullen Fund, the bequest of the late president of the Atlantic Gulf and Pacific Company, will not diminish benefits received by other students. The College of Engineering is completing the annual selection of more than thirty secondary school seniors from all parts of the country for four- or five-year McMullen Regional Scholarships, and fifteen McMullen graduate scholars have been appointed. In addition, more than fifty students in the three upper classes next year will receive aid through McMullen undergraduate scholarships. One out of every six students in the College of Engineering now receives some sort of aid from this fund, which is continually being increased by the income from stock in the company.

THE PAN-AMERICAN CONGRESS OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

TENTATIVE plans for the meeting in Cleveland on October 11 and 12 of the Pan-American Congress of Ophthalmology and Otolaryngology have already been reported in SCIENCE.

The first event of the congress will be a joint banquet with the academy on Wednesday evening, October 9, at which Dr. Frank Brawley of Chicago, president of the academy, will preside. On Thursday afternoon, October 10, the official delegates appointed by the various governments will meet with representatives of ophthalmologic societies to draw up a constitution and make plans for future meetings. Official recognition of the congress will be extended by the city of Cleveland at a reception on Friday evening, October 11.

The scientific program will occupy both Friday and Saturday. Papers will be divided equally between speakers from the Latin American countries and those from the United States. Papers in Spanish or Portuguese will be discussed by English-speaking physicians, and those presented in English will be discussed by Latin American speakers. Slides showing a résumé of each paper will be shown on a screen in the two languages other than the one being spoken.

Among those from South American countries who will appear on the program will be:

Dr. Pereira Gomes, chief of an eye clinic at the General Hospital, Saõ Paulo, Brazil.

Dr. Cesario de Ondrade, professor of ophthalmology, Faculdade de Medicina, Cirurgia y Pharmacia, Bahia, Brazil.

Dr. A. Vasquez Barriere, professor of ophthalmology, on the faculty of medicine of the University of Montevideo, Uruguay.

Dr. Carlos Charlin, professor of ophthalmology, University of Santiago, Chile.

Dr. Santiago Barrenechea, assistant professor of ophthalmology, University of Santiago.

In addition, there will be Dr. Arturo Quevedo, Guatemala City; Tomas R. Yanes, Habana, Cuba, editor of the *Revista Cubana de Oto-Neuro-Oftalmiatria;* Rafael Silva, Mexico City, for many years secretary of the Sociedad Mexicana de Oftalmologia y Otorinologia; Manuel U. Troncoso, formerly of Mexico and now of New York, and Manuel Marquez y Rodriguez, formerly a prominent ophthalmologist and teacher in Madrid, now living in Mexico City.

Among those who will discuss papers presented in English will be: Drs. Horacio Ferrer, Habana; Mendonca de Barros and Feliciano Penido Burnier, Saõ Paulo; Heitor Marback, Bahia, and Aniceto Solares, La Paz, Bolivia.

SCIENTIFIC NOTES AND NEWS

SIR OLIVER LODGE, who was from 1881 to 1900 professor of physics and mathematics at University College, Liverpool, and from 1900 to 1919 principal of Birmingham University, died on August 22 at the age of eighty-nine years.

DR. PHILIP FOX has been requested to resign from the directorship of the Museum of Science and Industry, Chicago, by the newly elected president, Lenox R. Lohr. As has already been recorded in SCIENCE, the first action of Mr. Lohr was the summary dismissal of nine of twelve members of the staff, including five of nine curators and others in key positions.

DR. CHARLES PACKARD, of the Institute of Cancer Research at Columbia University, was appointed director of the Marine Biological Laboratory at Woods Hole at the annual meeting of its Board of Trustees. He had been associate director since 1938, and previously had served as clerk of the corporation for seven years. At the corporation meeting, Drs. C. W. Metz, Harold H. Plough and Dugald E. S. Brown were elected members of the Board of Trustees.

THE degree of doctor of engineering was conferred on the occasion of the commencement exercises of the South Dakota School of Mines and of the Michigan College of Mining and Technology on John Van Nostrand Dorr, consulting metallurgist, president of the Dorr Company, Inc., of New York City, "in recognition of his contributions to chemical, metallurgical and sanitary engineering practices." Mr. Dorr gave the commencement address at both institutions.

THERE was recently unveiled in the Mississippi State Chemical Laboratory a bronze tablet that reads in part: "A tribute to William Flowers Hand, scientist, whose unselfish service, tireless energy and devotion to the education of youth of Mississippi and whose distinguished activities as State Chemist merit the naming of this building in his honor." In taking this action the Board of Trustees said that they were grateful "for the fine work that Dr. Hand had done, was doing and would do in the future for the State of Mississippi." Dr. Hand has been professor of chemistry and state chemist for forty years, dean of science for twenty-five years and vice-president of Mississippi State College for six years.

DR. L. J. H. TEAKLE, of the Department of Agriculture, Perth, Australia, has recently been elected a fellow of the Australian and New Zealand Association for the Advancement of Science and a member of the National Research Council.

H. W. SWANN has accepted the invitation of the Executive Council of the British Association of Supervising Electrical Engineers to continue as president of the association for a further year.

DR. DONALD PRICE, technical director of the Organic Research Laboratories for the National Oil Products Company of Harrison, N. J., was elected chairman for 1940–41 of the New York Metropolitan Microchemical Society at the ninth regular meeting at Fordham University. Dr. Price succeeds Dr. Alexander Knoll, of Columbia University.

DR. D. J. STRUIK, associate professor of mathematics at the Massachusetts Institute of Technology, has been promoted to a professorship.

DR. RALPH ORLANDO FREELAND, of the department of plant physiology of the Ohio State University since 1931, becomes associate professor of botany at Northwestern University on September 1.

DR. HUBERT R. HATHAWAY, of the General Hospital of the University of Wisconsin, an expert on anesthesia, has joined the staff of the Medical School of the University of California in San Francisco.

DR. EARL C. GILBERT, professor of chemistry at the Oregon State College at Corvallis, has been made acting head of the department.

DR. T. SLATER PRICE has retired from the professorship of chemistry at the Heriot-Watt Technical College, Edinburgh.

DR. HANS O. HATERIUS, Wayne University College of Medicine, has been appointed editor of the section on Endocrinology in *Biological Abstracts*. The journal *Endocrinology* will devote the abstract sections of future issues to reporting advances in the field of clinical endocrinology. *Biological Abstracts* will carry abstracts of experimental endocrinology.

DR. JOHN E. PERRY, professor of civil engineering at Cornell University, is again this summer director of Camp Barton, conducted by the Louis Agassiz Fuertes Council, Boy Scouts, on the west shore of Cayuga Lake. This is his fifth season as director.

FOLLOWING the nomination of Secretary Henry A. Wallace for vice-president of the United States on the Democratic ticket, Claude R. Wickard, under-secretary of agriculture, has been named his successor, and Paul H. Appleby, assistant to Mr. Wallace since 1933, has been named under-secretary.

DR. FRANK N. FREEMAN, dean of the School of Education of the University of California, has become a member of the Problems and Plans Committee of the American Council on Education.

THE Committee on Scientific Research of the American Medical Association has made a grant to Dr.

Rucker Cleveland of the department of anatomy at Vanderbilt Medical School for further research in the field of endocrinology and reproduction.

DR. H. V. S. GRILLO, president of the National College of Agriculture of Brazil, sailed from New York for Rio de Janeiro on August 23. He had spent three months in the United States studying the organization of agricultural institutions.

DR. H. VICTOR NEHER and Dr. William Pickering, of the Massachusetts Institute of Technology, have left Pasadena for an expedition to South Dakota, Oklahoma and Texas to make a further study of cosmic radiation.

A FIELD party headed by Richard K. Mellon, a member of the North American Hall committee of the American Museum of Natural History, left Pittsburgh on August 23 for an expedition to Alaska to collect additional material for the new Osborn Caribou Group now under construction. The party, which includes Mrs. Mellon, will charter a boat at Seattle, cruise along the inland passage along British Columbia and Alaska, and is expected to reach Seward, Alaska, about September 1, from which point the collection of material will commence. Robert H. Rockwell, of the museum staff, is accompanying the expedition as technical adviser. Mr. Rockwell will be principally concerned with gathering flora for the Caribou Group.

THE Glass Division of the American Ceramic Society will meet at Hershey, Pa., on September 6 and 7. There will be technical papers and reports on Friday and Saturday mornings. On Saturday afternoon a golf tournament and visits to points of interest in Hershey have been arranged. In the evening there will be a banquet followed by dancing at the Hershey Park Ballroom.

APPLICATIONS for the Lewis Cass Ledyard fellowship award of the Society of the New York Hospital close on September 15. The income from the fellowship, which was established in 1939, amounts to approximately $4,000, of which $1,000 will be used for supplies and expenses. Preference will be given to younger applicants, who are graduates in medicine and have demonstrated ability to carry on original research of a high order. Applications and correspondence should be addressed to The Committee of The Lewis Cass Ledyard, Jr. Fellowship, The Society of The New York Hospital, 525 East 68th Street, New York, N. Y.

A PLAN which will enable young Central American physicians to take special training at the Medical School of the University of California has been announced. According to the terms of the plan, two young graduate physicians who can speak English will be sent every year by each of the Central American nations for two years' special study in pre-clinical and clinical subjects under the guidance of an advisory committee. The committee, which will consist of Drs. Howard C. Naffziger, professor of surgery; Charles L. Connor, professor of pathology, and Ralph Soto-Hall, clinical instructor in orthopedic surgery, will assist each visiting physician in planning the type of special training which will be most valuable to him. No formal courses will be given. Countries sending representatives include Costa Rica, Salvador, Guatemala, Honduras and Nicaragua.

PRESIDENT WALLACE W. ATWOOD, of Clark University, in cooperation with the staff of the School of Geography, will conduct a graduate seminar during the coming academic year, taking as the special theme: Geography in National Defense. Provided that there is a registration of at least twenty men the School of Geography will offer a special course for undergraduate men, selecting from the various fields of geography those phases of the science that should be incorporated in the training of men who may wish to qualify as officers in the Army or Navy or to go into public service associated with the work of national defense. Certain phases of political geography may be introduced. The course will be evolved as the work proceeds and will be under the general direction of President Atwood.

THE *Journal* of the American Medical Association reports that at a joint meeting of the trustees of the North Carolina Baptist Hospital and of Wake Forest College, on July 18, contracts were let for the new Bowman Gray School of Medicine of Wake Forest College in Winston-Salem and additions to the hospital amounting to $701,572. It is estimated that it will take a year to complete the buildings. The school will also have a fifty-bed hospital which has been leased to it by the Junior League of Winston-Salem for teaching and research in psychiatry. The school will assume responsibility for the professional conduct of the child guidance clinic conducted by the league.

ACCORDING to the *Journal* of the American Medical Association the Illinois State Health Department presented two new exhibits in its annual health exposition at the State Fair in Springfield from August 17 to 25 in cooperation with the Public Service Company of Northern Illinois. One depicted the hazards of night driving and the inability of the eye to cope with these hazards. Dioramas, transparencies, working models, apparatus, street and highway lighting units and the scientific equipment used in research on the subject were shown. The other exhibit showed 2,000 years of progress in the evolution of resuscita-

tion from drowning, gas asphyxiation and electric shock. Dr. Hart E. Fisher, Chicago, chief surgeon of the public service company, was in charge. Other features of the exposition were free blood tests, medical examination of children, exhibits on "contact" diseases and nutrition. A motion picture program was presented daily.

IN the British Parliament Sir Thomas Moore recently asked the Minister of Supply whether he could give an assurance that in the limitation of paper supplies due regard would be had for the relative importance of various publications, and that reasonable preference would be given to the requirements of those publishing educational, scientific and technical journals and books. Mr. Harold Macmillan, parliamentary secretary to the Minister of Supply, replied: "While the Minister can not accept the responsibility for introducing in the allocation of the limited supplies of paper anything which might savor of a censorship, due regard will be had to the provision of reasonable amounts of paper for educational, scientific and technical publications."

ACCORDING to the London *Times* a new government technical school at Takoradi, West Africa, built on 30 acres of grounds at a cost of £37,000 has been opened. The school had to be removed from Accra, partly because the accommodation there was inadequate to meet the growing demand for technical training, partly because the new site is more accessible for the industrialized areas of the Gold Coast. The school overlooks Takoradi harbor and includes a long, single-story workshop with blacksmith's shop, a demonstration block of three stories, with classrooms, laboratories, drawing offices and assembly hall. Over 100 students can be housed in the dormitory block. The workshop provides for instruction in two sections: one for practical work in mechanical engineering, the other for practical woodwork. Both sections are fitted with electrically driven machinery and the usual benches for manual work. Two blocks contain quarters for African masters, and there is a bungalow for a European housemaster. The buildings are grouped around a sports ground of five acres. Most classrooms and the assembly hall are wired for reception of wireless programs from the Sekondi station. Present students include boys from all parts of the Gold Coast.

DISCUSSION

A STANDARD EXPERIMENTAL VEGETATION TYPE

THE increasing interest in land with its attendant problems of animal and plant ecology is emphasizing the long-felt need for outdoor and laboratory facilities "where the interactions of land plants and animals and their physiological relations to climate can be studied."[1] In an integrated investigation of this or a related nature, one of the essential parts would be an area sufficiently protected to permit development of the vegetation so as to form a standard and at the same time afford an experiment in itself.

The purpose of adequately protecting a plant cover over a long period can be stated as: What can the two, soil and climate, produce, given certain species of plants, if productivity is not upset by removal of vegetation? We can only guess at the outcome. What will the product be in a definite period of 5, 10 or 15 years or in an indefinitely long period of over 100 years and more? Will development proceed far beyond what we conceive of as the climax for the region? Will it be a more or a less desirable type than the accepted climax, either as forage or as a protective cover for the soil? How will it compare with areas continuously grazed by livestock for the same period and how will it compare with the vegetation on portions of such an area as mentioned by Shelford—"large enough to prevent domestication of plains animals and to be managed on a hands-off basis"?

Without proper protection outdoor studies dealing with the development of vegetation or with competition between plants may be upset at a crucial moment by the destruction of vegetation through one or another of many agencies. Plowing, fire, roadway construction, excessive grazing by livestock and the feeding of rodents or of insects such as grasshoppers or Mormon crickets, all take toll of plots situated in the open ranges and only by chance can a plot be expected to survive intact for long. Elimination of one or a few of the agencies, such as fencing to keep out large animals, may temporarily reduce the destruction of vegetation but it is no dependable solution. The accumulation of plant material on an area surrounded by land where such material is scarce is a stimulus for concentrations or for multiplication of the uncontrolled smaller animals. The resulting damage to the vegetation may be obscure and lead to erroneous conclusions. Sometimes the damage is pronounced. In two 40-acre experimental tracts[2] where fire and grazing had been prevented, jackrabbits suppressed an annual grass in the one, and in the other reduced a sparse vegetation to bare soil.

[1] V. E. Shelford, SCIENCE, 90: 2346, December 15, 1939.

[2] R. L. Piemeisel, U. S. Dept. Agric. Tech. Bull. 654, 1938; also unpublished data.

Some outdoor plant ecological investigations call for a place to work where the removal of vegetation has been reduced to such a low point that the experimenter can safely consider it negligible. The vegetation must remain intact or nearly so. This is not as unreasonable as it may seem at first glance. Fire can be prevented; adequate fencing can keep out the large animals; means of control are known for rodents and for the insects that cause mass destruction of vegetation. It would seem unnecessary to prevent either casual or slight though wide-spread loss such as a leaf or a few leaves taken off individual plants by a leaf-chewing insect or by a plant disease. At what point damage may be disregarded must at the outset be determined by extensive field experience but later may be aided by methods devised to measure and to record damage. Repeated inspections and a series of records for the season should give the amount of damage in any year and it may be hoped that in time the crucial point (at which damage can be considered negligible) may be stated as a definite figure and that control practices as required would become routine. In short, while the ideal would be to prevent all loss of vegetation, practically this is not feasible and perhaps not necessary, so that it is more important that the amount of deviation from the ideal should be known rather than that the minimal loss be prevented.

The question raised in the fore part of this paper, "What can the soil and climate produce?" would obviously be answered best by adequately protecting a community of perennials, one as near to the accepted climax as possible. However, it is equally desirable to adequately protect a vegetation area in a secondary succession stage so as to throw light on the nature and rate of development and also to serve as a comparison to other areas in a similar developmental stage. Moreover, since the early stages of secondary successions are composed of annuals and there is an exceedingly rapid turnover, a generation for each year, such communities are particularly adapted to some such investigations as were suggested by recent studies of semi-desert vegetation.[2] In these it was shown that the removal of vegetation has a pronounced effect on communities of annuals. Thus by preventing excessive removal of vegetation the development of the early stages of secondary successions proceeded from initial weed stages to a third or annual grass stage. But by inducing excessive removal of vegetation (as by enclosed stock) the process was reversed from the third stage to the initial weed stages. Also, by this same method the development was arrested and maintained at the initial weed stage. Although the gross effect of the removal of vegetation is known, a field of investigation is open to measure this effect on communities of annuals in terms of (*a*) number of animals, (*b*) length of time, (*c*) resulting vegetation, the latter measured by comparison with an adequately protected area.

Another important study is suggested by the severe competition and the very rapid turnover in communities of annuals which make them particularly suited to the study of competition in successive generations, that is, to determine the effect of competition in one year or generation and to follow up its results in the next generation and the next and so on. Outdoor statistical studies of such competition are lacking[2] and if carried out under conditions where destruction of vegetation is negligible might lead to the formulation of some fundamental principles underlying competition between plants in general.

In the past, protection has been directed at the elimination of one or more destructive agencies, but so far as the writer is aware there are no long-time records on protected plant communities where loss of vegetation which may have occurred from one cause or another was measured and shown to be negligible. Changes in plant cover on insufficiently protected or wholly unprotected areas can not be ascribed with certainty to differences in physical factors—drought, for instance—if the destruction of vegetation has been disregarded or unmeasured. The marked modifications of communities of annuals previously mentioned were produced, irrespective of any noticeable changes in physical factors such as "wet" and "drought" years, and the development through its stages was induced, was halted or was reversed merely by manipulating the removal of vegetation, that is, by preventing removal or by producing excessive removal. Since within specified limits we can mold communities of annuals as we wish, to what extent can we mold communities of perennials if given a proportionately long time?

Steenis[3] asks, "Is there any undisturbed vegetation on earth?" Whether we agree or disagree with him, the question remains a challenge to show by measurements in any particular region either that there has been no disturbance, or how much has occurred. Measurements can be obtained if there are "standard" vegetation types for comparison. The large tract mentioned by Shelford, and already referred to, should afford one kind of standard if it were maintained for a sufficiently long time so as to approach a natural balance between plants and animals. Another standard should be an area such as is here proposed, adequately protected and maintained for a long period. In short, in the former we would have a plant cover resulting from a "natural" removal of vegeta-

[3] C. G. G. J. Steenis, *Bull. du Jardin Botanique.* Serie III, Vol. XIV, December, 1936.

tion, in the latter, one resulting from the least possible removal of vegetation. Both of these could then be compared with other plant covers that had been used or treated in various ways under controlled conditions as well as under the existing land-use practices of to-day. From this we could in time obtain a series of values and so arrange a scale, for example, with bare soil as zero, then somewhat higher, the heavily-grazed type, and near the upper end, the standard types just mentioned.

In time such values would afford a basis for recommendations regarding sound land-use practices. How can we determine better the part that physical factors —drought, for instance—play and the part that destruction of vegetation (including disturbance caused by man) plays than by attempting to reproduce, through experiment, the effects we see and believe we understand? However, to achieve this there must be some standard for comparison.

R. L. PIEMEISEL

U. S. SUGAR PLANT FIELD LABORATORY,
TWIN FALLS, IDAHO

THE MUSEUM AS A POTENTIAL FORCE FOR SOCIAL ENLIGHTENMENT

ONE of the primary functions of the museum is that of education. Thus the schools usually have their children visit the museum more or less regularly, and the public at large is generally also permitted this privilege without charge. Considering the adult population primarily, several questions come to mind. First, assuming that a fair proportion of the adult community has been to the museum once, one wonders how many of this group *revisit* the exhibits and at what intervals? Second, what do the visitors actually see when visiting the museum, and how much of what is seen is remembered? And third, of what significance does it all seem to the general run of visitors?

I am not acquainted with the literature on museum administration, and research based on the above queries may already be available. In any case, my own observations (and the response of a number of other individuals with whom the subject has been discussed support these views), point to the following conditions: (1) Relatively very few in the community visit the museum (*i.e.*, the exhibits) more than once a year, if that often. (2) When the museum is visited, the usual thing is to try and see everything, and since observing all the exhibits in even a single hall in a large museum is physically fatiguing, an excursion through the whole museum is generally an exhausting experience. Indeed, as a result of these latter two considerations, the usual visit to the museum can scarcely be more than a superficial survey, at best. (3) With respect to significance of the exhibits, the attitude of the vast majority of the visitors would probably be that they were all curious and very interesting—but little more.

If the above observations are substantially correct, it seems to me difficult to escape the conclusion that the museums have in large measure failed to make any considerable or lasting impression on the thought or mores of the community at large.

It is not my purpose to belittle the cultural advantages of the modern museum of natural history. On the contrary, this note is prompted by the belief that the museum can and should be a definite and potent influence for tolerance and understanding among peoples, and the following suggestions are proposed with that end in mind.

In order to get the people, and by people I mean folk from all walks of life, not merely the "educated" groups, to come to the museum often and regularly, the exhibits should be imbued with *movement*, which tends to attract and hold the interest. Thus, the fascinating story of man's biological history, his ethnological and cultural differentiation, and the like, could be told by means of moving and talking pictures, in serial fashion, just as the modern planetarium each month relates a different chapter in the story of the heavens. As in the planetarium, also, the visitors would be seated comfortably for the "show," and the factor of fatigue would be eliminated. The latter, as well as the fact that attention would be focused on one exhibit story, and over a long period of time, should be conducive to retention of what was seen and heard. Perhaps of most importance, however, is that each science thus presented, and especially the anthropological and social sciences, could and must be intelligently related to the present, everyday world of the people witnessing the exhibits: otherwise, as now, the response would probably be mere esoteric interest. For example, combined with the exhibits and explanation of the material or social culture of the American Indian would also be an account of their contributions to our present mode of living, and what is more, how similar the fundamental drives and sanctions were for them as for us to-day, albeit expressed more or less differently as a result of another day and culture, a discrepancy which should also be noted with reference to our own behavior in the course of time.

It should also be noted that our great museums serve the large urban centers primarily. True, in these days of relatively easy travel, many persons from all over the country get to visit the large cities at one time or another, and these may go to the museum. However, there are probably millions of others in our rural sections of the country who have never had the opportunity of attending a good museum even once. Yet the cultural treasures of the greatest museums could be brought to all the people, in rural as well as in urban communities, by means of motion pictures.

Most of us tend to think of the present as having always been with us, and our social intelligence is apt to be limited if not warped in consequence. Effective demonstration through the medium of motion pictures of the relative recency of most of our customs and beliefs should perforce tend to broaden perspective and tolerance among peoples. Finally, the barrier of language-differences could be surmounted in motion pictures (using sub-titles when necessary), thereby also enhancing social intercourse and understanding. In short, it is my contention that motion-talking pictures, intelligently utilized by the museum, could make the museum a great force for social as well as intellectual enlightenment.

The practical question of financing such an undertaking as proposed is probably the most serious obstacle in its path, whether an insurmountable one or not, I do not know.

MARCUS S. GOLDSTEIN

UNIVERSITY OF TEXAS

ELECTRODES SEALED IN GLASS TUBING

GARRETT, Hogge and Heiks[1] have noticed erratic potentials in the use of platinum electrodes sealed in glass tubing. The source of trouble was located at the glass-metal-solution interface. They did not mention the type of glass used. Some years ago I noticed that platinum electrodes sealed in Pyrex glass gave very poor results in the titration of ferrous sulfate with dichromate, or the reverse.[2] On finding that electrodes made with soft glass behaved satisfactorily, I abandoned the Pyrex and had no further trouble. While erratic behavior in some cells may be attributable to this cause, there is evidence that junctions of soft glass and platinum can at least sometimes be immersed in solutions without erratic results. For example, some lead-iodine cells in which platinum electrodes were sealed in soft glass by means of lead-glass seals and immersed in a paste of lead iodide, iodine and electrolyte were found unusually reproducible.[3] It seems that the immersion of a platinum-glass interface does not invariably lead to erratic results, and further light on the source of trouble and how to avoid it would be welcome.

WARREN C. VOSBURGH

DUKE UNIVERSITY

SCIENTIFIC BOOKS

PHYSICS

Classical and Modern Physics, A Descriptive Introduction. By HARVEY E. WHITE. 707 pp. New York: D. Van Nostrand and Company. 1940. $3.75.

IT is doubtless a truism that teaching is yet an art and the art of an individual teacher. Be the educational objective ever so clearly defined the good teacher must and will follow his own procedure, irrespective of whether others agree or can follow in his path or not. To anyone who has had recourse to the admirable pictorialization of the atoms and their spectra presented in White's "Introduction to Atomic Spectra" it will be obvious that in his more elementary presentations this author must employ to an even greater extent his very clear and vivid graphical and visual methods. The perfection of the text-book on review is thus the expression of the art of the author in his attempt to solve a teaching problem. The task set is not an easy one. The problem of presenting a stimulating one-semester survey course in physics of collegiate grade interesting alike to students who have or who have not taken high-school physics is no mean task.

The objectives which the author sets himself to accomplish are as follows: "First to start as nearly as possible at the beginning of each subject, second to develop each new concept or phenomenon so that a student with some knowledge of the simplest principles of algebra and plane geometry should have no difficulty in following; and third to adequately illustrate each subject and chapter with diagrams and photographs."

In each of these the author quite successfully accomplishes his mission. The presentation of the classical physics must in the nature of the objectives be brief, but the essentials are all there. The style is terse and crisp. The physics is excellent and the illustrations are adequate. The few equations presented are not too difficult and the numerical examples of solutions of these equations facilitate the student's understanding. At times one feels that unnecessarily many examples of some less important principles are given, (*e.g.*, optical illusions), but in general no example of an important principle capable of ready pictorialization has been omitted. In reading the book one wishes that there were a bit more discussion of the subjects in some of the earlier chapters and particularly that more attempts were made to correlate and connect the various chapters and sections. For in reality the whole of classical physics is bound together by the Newtonian system. The failure to do this gives the reader the impression that physics consists of a confusingly great number of relatively unrelated facts, which in a survey

[1] A. B. Garrett, E. Hogge and R. Heiks, SCIENCE, 92: 18, 1940.

[2] W. C. Vosburgh, *Jour. Am. Chem. Soc.*, 44: 2155, 1922.

[3] W. C. Vosburgh and V. H. Dibeler, *Jour. Am. Chem. Soc.*, 61: 2522–2523, 1939.

course is most unfortunate. It is in this respect that the reviewer most questions the value of the purely pictorial mode of approach. In part, of course, this lack of coordination is the consequence of the necessary condensation of the topic. Perhaps the weakest chapters are those on electrical phenomena, owing undoubtedly to the great difficulty which one has in depicting the involved nature of electrical phenomena especially without adequate space in which to develop the concepts. Both this section and that on light suffer in that they tend to stress the *applications* of the phenomena perhaps too much at the expense of the fundamental concepts.

Concerning the presentation of the modern physics the author states as follows: "The treatment of modern physics here is given more or less in its historical development. Wherever feasible the presentation of each new subject includes first a brief historical account of the discovery, second an experimental demonstration of the phenomenon, third a discussion of practical applications accompanied by one or more experiments, and fourth a brief account of the accepted theory and its experimental confirmation." In this later procedure the author is far more successful in the second half of the book than in the first, for more space is allotted to the development of each topic. For a book of this type the text is remarkably free from the dogmatism that can so readily creep into such a text.

The drawings are exceptionally fine, and the make-up and printing of the book are excellent. The short biographical sketches of the various contributors to physics appearing as footnotes are a most fortunate addition. As a whole the book is conventional enough to be widely used in survey courses, while its original and vivid, yet dignified pictorialization lends it an air differing quite markedly from the usual college texts.

LEONARD B. LOEB

SMASHING ATOMS

Why Smash Atoms? By ARTHUR K. SOLOMON. 174 pp. Cambridge: Harvard University Press. 1940. $2.50.

OF the many books attempting to popularize modern physical advances this book presents an interesting innovation: In the first place it confines itself to a limited field, *viz.*, atomic disintegration. In the second place it strives to lay an adequate scientific background for the discussion before attempting it. In clear, simple and elegant English it develops a layman's picture of the atom and its constituents, proceeding in a logical and somewhat historical manner. This being accomplished in the first fifty pages, the author then proceeds to discuss nuclear transmutations and smashing devices, as well as the detecting instruments used. In the third portion of the book in some 30 pages the results of nuclear reactions, including uranium fission, are presented. The applications of the nuclear disintegrations to medicine and other fields are also briefly given. The presentation of the principles of high energy particle production, as well as the difficulties of cyclotron operation with which the author is familiar, are particularly good. The author must, however, be congratulated in general for the facility of presentation of scientific material to the lay public which is in evidence throughout.

To the reviewer who grew up with the development of this subject and who, together with Marsden in 1919, was the first to check the artificial disintegration of N by α-particles in Rutherford's laboratory before the results were published, the liberties taken by the author with scientific history are particularly irritating. In a measure some of these difficulties are to be ascribed to the author's avowed policy, "I have deliberately omitted the names of many whose work is fundamental to nuclear physics, not because I do not appreciate the nature of their contributions, but for the more practical reason that too many names would confuse the reader." Whether this confusion would result or not were more names included is in itself highly debatable. Leaving this aside, however, there is no justification whatsoever for bringing Franklin's name preeminently into the fundamentals of the early discoveries of static electricity. Much as we revere our Franklin, his contributions to the subject were negligible except for proposing the single fluid theory of electricity. The implication to an uninstructed public that these advances were due to Franklin is most misleading. Either *no* names should have been mentioned or *more* names should have been mentioned. Misconceptions of this character are frequently invoked in sections of the book. There are other errors of omission equally annoying, such as the omission of all mention that prior to Moseley in 1913 the concept of nuclear charge and atomic number had clearly been put forward by Van den Broek, Soddy and Fajans on the basis of the chemistry of the radio elements. The descriptions in the first portion of the book are clarified through the use of simple but unnecessarily crude line drawings. One wonders, however, why the dignity of an otherwise good lay presentation of a scientific subject must be marred by irrelevant animal cartoons such as the black and white birds on page 37, representing α and β-particles supposedly emitted in the uranium series. On the other hand, the photographs of the various sources of high energy particles as well as those of cloud tracks are among the best so far reproduced in texts. It would, however, have been better for the reader if more accurate descriptions of these figures could have been embodied in and correlated

with the text. Aside from these marring features the book constitutes a real contribution to the popularization of modern physics.

LEONARD B. LOEB

PHYTOPATHOGENIC VIRUSES

Handbook of Phytopathogenic Viruses. By FRANCIS O. HOLMES. vii + 221 pp. Minneapolis: Burgess Publishing Company. 1939. $2.00.

THE virous nature of certain diseases of plants has been known since 1892, when Iwanowski described the filterable nature of tobacco mosaic which Beijerinck confirmed in 1898 and interpreted as being a "contagium virum fluidum." Since then many virous diseases of plants have been described, and numerous attempts have been made to roughly classify them.

The present effort of Dr. Holmes to bring out an orderly presentation of these diseases carries far beyond any previous attempt at nomenclatorial classification. He has adopted the Linnean system in common use for the higher biologic forms, applying Latin binomials for virous names. He has also applied common names in accordance and has included the recognized vulgar synonyms.

The author has included as separate entities in this work 129 viruses of seed plants which he considers to be sufficiently distinctive to deserve specific binomial or trinomial designation. In addition he has described under Latin binomials those bacteriophages which can be recognized as distinctive.

Specifically this work treats only those virous entities known to attack plants, including bacteria, under the division Phytophagi. This division is separated into two classes, Schizophytophagi and Spermatophytophagi. The former embraces one family, Phagaceae, in which 40 bacteriophagic species and two varieties are recognized under one genus *Phagus,* of which the type is *P. minimus* (Bacteriophage S13 of the colon and dysentery bacteria).

The Spermatophytophagi contains ten families based largely on symptoms produced on typical host plants.

Family 1. Chlorogenaceae, which is typified by *Chlorogenus callistephi,* the aster yellow virus. The author recognizes nine species and five varieties in this genus.

Family 2. Marmoraceae likewise contains one genus *Marmor* with 53 species and 26 varieties, of which *M. tabaci,* the tobacco mosaic virus, is the type. This largest family contains the more commonly recognized virous diseases which produce mottling or mosaic symptoms.

The remaining eight families are small but distinctive. The Annulaceae embraces four species and three varieties characterized as the ringspot family, of which *Annulus tabaci* causing tobacco ringspot is the type. The Gallaceae or Fiji-disease group with four species is characterized by vascular proliferations of which *Galla Fijiensis* causing Fiji disease of sugar-cane is the type. The Acrogenaceae (spindle-tuber group); Rugaceae (leaf-curl group); Coriaceae (leaf-roll group); Nanaceae (dwarf-disease group) complete the families of the Spermatophytophagi. Each species is treated in a systematic manner under synonyms, suscepts, immunes, geographical distribution, induced disease, transmission, serology, immunology, thermal inactivation, filterability, other properties such as crystallization, sedimentation, molecular weights, etc., control and literature.

The two supplements contain respectively a list of susceptible and insusceptible plants and a list of viruses not treated in the book and about which too little is known for classification. The work is concluded with an adequate index.

The author has stepped out and given his colleagues in the virous field a conception of these entities which must be taken seriously. Whatever is the final decision regarding the nature of viruses, his method of classification is certainly scientific and will appeal to those of us who can not remember whether aucuba-mosaic virus is the same as tobacco virus 6 and nicotiana virus 10. Furthermore, Dr. Holmes has brought together in a convenient form the most accurate information extant on these most interesting and important entities and thus has performed a real service to phytopathology.

As a novelty the book is lithoprinted and loose-leaved and has a spiral metal binding which opens flat, with cardboard covers.

C. R. ORTON

WEST VIRGINIA UNIVERSITY

PLANT MICROTECHNIQUE

Plant Microtechnique. By DONALD A. JOHANSEN. xi + 523 pp. New York: McGraw-Hill Book Company. 1940. $4.50.

THIS is the most extensive review of microtechnical methods as applied to botanical materials that has yet appeared, at least in English. In addition to the space devoted to the more familiar problems of fixation, dehydration, imbedding, sectioning, staining and the preparation of whole mounts, one chapter discusses with satisfying fullness the recently developed smear methods, and another outlines some of the most useful microchemical manipulations. More than 200 pages are devoted to a systematic discussion of special details of culture, preservation for morphological purposes and the cytological treatment of members of all the plant groups from Schizophyta to Anthophyta.

The book, as the preface points out, does not attempt the impossible task of being encyclopedic. In the course of the necessary selection, the author has chosen

methods either because they are widely used or because they have shown their value in tests made by him or under his supervision. Dr. Johansen's experience and his well-known contributions to technique guarantee the value of his recommendations. It is true, of course, in a field in which experience varies so greatly and in which success is dependent upon so many uncontrollable factors, including the personal one, that any experienced technician will find reason to question some of the author's conclusions and to regret certain of his omissions. However, granting limitations of space, no one writer probably could have made a better selection.

The subject-matter is presented clearly and fully enough to be usable by a beginner. On the other hand, so much is included and so many useful hints as to detail are presented that the book will be of value to all workers in its field, however extensive their experience. The author has given us an important and a thoroughly up-to-date contribution.

C. E. ALLEN

THE UNIVERSITY OF WISCONSIN

REPORTS

COOPERATIVE INVESTIGATIONS OF THE RELATION BETWEEN MOSQUITO CONTROL AND WILDLIFE CONSERVATION[1]

SINCE the creation of the Tennessee Valley Authority in 1933, the Tennessee River has been converted into a series of large reservoirs. This change from river to lake conditions has necessitated certain major biological readjustments within the area. These adjustments concern not only the valuable wildlife and fisheries of the region, but create potential hazards to the health of man, particularly with regard to increased production of anopheline mosquitoes capable of transmitting malaria. Although these attendant changes are not unique to the Tennessee Valley, but have occurred, or will occur, in other large impoundments in the South, nevertheless the Authority has felt obligated to investigate the possible conflict between malaria control procedures and wildlife conservation.

On February 28, 1939, a meeting was held in Knoxville, Tennessee, which was attended by representatives of the Federal Bureau of Biological Survey, Public Health Service, Bureau of Fisheries, Bureau of Entomology and Plant Quarantine, and departments of the TVA interested in wildlife conservation and mosquito control. A second meeting was held on May 8. After full discussion of mutual interests, a Technical Committee was appointed to carry on a cooperative field study to obtain information on the nature and extent of the effect of mosquito larvicides and of water-level fluctuation upon fish and waterfowl, or upon their food supply; to consider possible substitution or modification of practices where damage was established; and to provide a mechanism for the coordination of the interests of the participating agencies. Representatives of the interested state agencies were invited to participate.

Members of the Technical Committee investigated the various problems jointly in the field, chiefly in Wheeler Reservoir,[2] during the summer of 1939. The continuous fluctuation of the water-level for anopheline control, together with the "over-all" fluctuations for flood control, navigation and other purposes, rendered it extremely difficult to separate the exact influence of these factors from one another and from other malaria control procedures. Variation of water-level results in the invasion of species of vegetation adaptable to such conditions. Certain of these species are undesirable, both from the viewpoint of wildlife conservation and malaria control. Wide variation of water-level inhibits the growth of submerged vegetation and of most of the indigenous emergent species of high value for waterfowl. Fluctuation also has a marked effect upon the qualitative and quantitative distribution of aquatic organisms.

Studies were conducted on the influence upon aquatic fauna and flora of the routine use of Paris green (applied by airplane at the rate of about one pound per acre) for the control of the malaria mosquito, *Anopheles quadrimaculatus*. These treatments showed no deleterious effect upon vegetation, and gave no evidence of a catastrophic destruction of aquatic organisms important as fish food. The great variability of conditions and the complicating factors in the experimental areas rendered these studies extremely difficult. For these reasons the data were inadequate to measure partial changes in the fauna which may have resulted. Chemical analyses of soil samples showed that arsenical residues accumulate in the bottom of the reservoirs in variable amounts.

In a general study, extending beyond the limits of the Tennessee Valley, on the effect of various poisons upon the physiology of fishes, representatives of the Bureau of Fisheries, working more or less independently of the studies of the Technical Committee, showed that, while arsenic accumulates in the fish of TVA reservoirs, the quantities stored to date in fishes are insufficient to be a menace to human consumption. This study is being continued to evaluate any additional storage which may develop. However, fish

[1] Report of the Technical Committee, May 14, 1940.

[2] A wildlife refuge was established in this reservoir by executive order, in August, 1938.

from these reservoirs gave evidence of disturbed metabolism, resulting possibly from malaria-control measures or other operations of the project.

Attention was also given to the effect of larvicidal oil (4 parts kerosene and 1 part black oil) as used routinely for mosquito control during 1939. Comparisons were made with kerosene (plus a dye as a marker) and with pyrethrum larvicide. The three materials showed similar results in that their deleterious effect was chiefly confined to the amphipods, of which a large proportion was destroyed. The larvicidal oil was toxic to vegetation when applied in excessive quantities, but resultant damage was more or less of a temporary nature, except that there was some evidence to indicate a tendency toward prevention of seed formation. Kerosene appeared to be the toxic constituent.

At a meeting of the participating agencies in Chattanooga, Tennessee, on February 28, 1940, it was agreed that the joint field study had resulted in the coordination of interests and that it should be continued during the summer of 1940. Investigations to be included are: (1) the relation of various species of aquatic vegetation to the production of *A. quadrimaculatus;* control of species of vegetation inimical to mosquito control and wildlife interests; and experimental plantings of species of vegetation desirable for wildlife propagation and relatively innocuous in mosquito production, (2) the biological influence of fluctuation of water-levels, (3) the source, rate of accumulation and the form in which arsenical residues occur in the bottom of the reservoir and the toxicity of these residues to aquatic fauna and flora, (4) the direct influence of Paris green and larvicidal oil on fish life, (5) natural predators of anopheline larvae, (6) the utilization of such supplementary malaria-control procedures as dykes, low-head dams, screening and mosquito-proofing; the restriction of land use to daytime occupation, and (7) new mosquito larvicides.

E. L. BISHOP,
Chairman, Policy Committee

SPECIAL ARTICLES

PANTOTHENIC ACID AND NUTRITIONAL ACHROMOTRICHIA IN RATS

DEPIGMENTATION of the fur, so-called "graying" in black and piebald animals and "rusting" in albino animals, can be produced with great regularity in rats fed a vitamin B-free basal diet (casein 18 per cent., sucrose 68, melted butterfat 8, cod liver oil 2, salt mixture 4) supplemented with thiamine, riboflavin and vitamin B_6 in an amount of 20 micrograms of each daily.[1-4] If the diet is devoid of vitamin B_6, this syndrome is less frequently observed, owing probably to the phenomenon of competition of vitamin-deficiency diseases—a B_6 deficiency *versus* lack of the anti-gray-hair factor.[5]

It has been shown[4] that purified but still crude concentrates of pantothenic acid with a degree of purification varying up to 50 per cent. had a definitely curative effect on this nutritional achromotrichia in rats. Thus it has been concluded that these concentrates contained a specific factor concerned in the cure of depigmentation of the pelt. This factor has been found to be heat labile; autoclaving of an alkaline solution destroyed the activity of the concentrates.

Although the parallelism between biological activity and grade of purification as well as heat lability of pantothenic acid favored the assumption that the specific anti-gray-hair factor is identical with pantothenic acid in the concentrates tested, the corresponding final conclusion had to be deferred until the experiments could be repeated with pure pantothenic acid.

Recently Nielsen, Oleson and Elvehjem[6] have reported the isolation of a crystalline substance which, when fed at 15 micrograms per rat per day, prevented achromotrichia. This substance was different from pantothenic acid. These authors point out that "the factor preventing nutritional achromotrichia should be clearly differentiated from pantothenic acid."

With the production of synthetic pantothenic acid,[7] sufficient amounts of the pure substance became available[8] for the study of its activity in nutritional achromotrichia in rats.

A large number (30) of rats suffering from deficiency of pantothenic acid with its different manifestations[4, 9] was treated with graduated doses of pantothenic acid. In this group 12 piebald and black animals were included, 6 of which had localized and 6 more extensive, generalized achromotrichia. The therapeutic effect of pantothenic acid on the depigmentation of the fur was prompt and definite. With the administration of daily doses of from 75 to 100

[1] P. György, *Biochem. Jour.*, 29: 741, 1935.
[2] A. F. Morgan, B. B. Cook and H. G. Davison, *Jour. Nutrition*, 15: 27, 1938.
[3] G. Lunde and H. Kringstad, *Zeit. Physiol. Chem.*, 257: 201, 1939.
[4] P. György, C. E. Poling and Y. SubbaRow, *Jour. Biol. Chem.*, 132: 789, 1940.
[5] P. György and H. Goldblatt, *Jour. Exper. Med.*, 70: 185, 1939.
[6] E. Nielsen, J. J. Oleson and C. A. Elvehjem, *Jour. Biol. Chem.*, 133: 637, 1940.
[7] R. J. Williams and R. T. Major, SCIENCE, 91: 246, 1940.
[8] Synthetic pantothenic acid was generously put at our disposal by Merck & Co., Inc., Rahway, N. J.
[9] P. György and R. E. Eckardt, *Nature*, 144: 512, 1939.

micrograms the bluish discoloration of the skin due to the first growth of normally pigmented hair shafts in the epidermis was noticed in from 5 to 7 days; with lower doses (50 micrograms), later. The appearance of the black fur then made rapid progress and the cure was practically complete with higher doses (75 to 100 micrograms) in from 5 to 7 weeks. In rats fed lower doses (50 micrograms), the cure was incomplete but the effect was still pronounced.

In summary, the statement appears to be warranted that pantothenic acid has a definitely curative effect on nutritional achromotrichia in rats fed a diet free from pantothenic acid.

PAUL GYÖRGY
C. EDWARD POLING[10]

THE BABIES AND CHILDRENS HOSPITAL,
AND THE DEPARTMENT OF PEDIATRICS,
SCHOOL OF MEDICINE, WESTERN RESERVE
UNIVERSITY, CLEVELAND

CRYSTALLINE VITAMIN A PALMITATE AND VITAMIN A ALCOHOL

THE preparation of crystalline vitamin A alcohol was first reported by Holmes in this journal.[1] From methyl alcohol yellow crystals were obtained, melting at 5–6° C, with an extinction coefficient at 328 mμ ($E^{1\%}_{1cm}$) of 2,000. Later Mead[2] repeated the preparation by Holmes's method and confirmed the melting point. Mead noted, however, that the crystals were not solvent free and suggested that solvent of crystallization might be present. This is to be noted in view of our findings. Extinction coefficients of 1800 and 1820 were found for the solvent-free A alcohol.

In this laboratory the need has long been recognized for a crystalline, natural ester of vitamin A suitable for use in correlating the spectrophotometric and biological assay of vitamin A, that is, in determining the conversion factor. It is now well established that vitamin A occurs in fish-liver oils, the chief source, esterified with long chain fatty acids. Tischer[3] has furthermore shown that vitamin A palmitate is one such ester. We, therefore, chose to make vitamin A palmitate, esterifying crystalline vitamin A alcohol to obtain the purest ester possible. This work has resulted in the preparation not only of the first crystalline fatty acid ester of vitamin A (so far as we know) but also of crystalline vitamin A alcohol, which melts much higher than hitherto reported.

In the preparation of vitamin A alcohol rich fish-liver oils were distilled in a cyclic molecular still. Distillates with extinction coefficients at 328 mμ of 400 or greater were combined and saponified, yielding vitamin A alcohol concentrates with extinction coefficients of 1,100–1,300. These usually crystallized readily, sometimes after redistillation, from their 10 per cent. solution in ethyl formate at −35° C. after sterols had been removed. After drying in a vacuum at low temperature, pale yellow prismatic crystals of vitamin A alcohol were obtained which were solvent free and melted at 63–64° C. Propylene oxide has also been used as a crystallizing solvent.

Vitamin A alcohol crystallized twice in this way has an average extinction coefficient at 328 mμ of 1,725. This is the average of eighteen preparations, some with extinctions measuring as high as 1,850. The average extinction coefficient at 328 mμ calculated from the blue value was slightly lower, namely, 1,700.

The ultraviolet absorption was measured with a Hilger quartz spectrograph, model E-498, with a Spekker ultraviolet photometer. Antimony tri-chloride blue values were determined with an Evelyn colorimeter standardized with a distilled vitamin A concentrate whose extinction coefficient had been repeatedly determined and checked by the non-saponifiable matter from U.S.P. reference oil.

The extinction coefficient of the vitamin A alcohol blue color with antimony tri-chloride was also determined using a Hardy recording spectrophotometer. The average value found was $E^{1\%}_{1cm}$ (622mμ) = 4700. Special precautions were taken to evaluate the transitory blue color at its maximum intensity.

Vitamin A palmitate was prepared by esterifying crystalline vitamin A alcohol with palmityl chloride and quinoline in chloroform solution at −15° C. The crude ester crystallized readily from a 2 per cent. solution in propylene oxide at −30° C, in pale yellow plates, m.p. 26–28° C.

After two crystallizations vitamin A palmitate has an average extinction coefficient of 940. The average extinction coefficient at 328 mμ calculated from the blue value was 933. This value of 940 corresponds to an extinction coefficient of 1,720 for vitamin A alcohol.

The extinction coefficient of the antimony trichloride blue color with crystalline vitamin A palmitate was found to be 2490 at 620 mμ. By calculation this gives a value of 4560 for vitamin A alcohol which is 3 per cent. lower than the value found by measurement for the crystalline alcohol.

Our value for the extinction coefficient of vitamin A alcohol is about 1,720, whether obtained by assaying the crystalline alcohol or by calculation from the extinction of the crystalline palmitate. This is about 4 per cent. lower than the value of 1,800 recorded by Mead from the assay of crystalline vitamin A alcohol and two esters, the anthraquinone-2-carboxylate and the 2-naphthoate. We do not exclude the possibility that our preparations are impure, but it seems

[10] S.M.A. Corporation fellow in biochemistry, assigned to the Department of Pediatrics.

[1] H. N. Holmes, SCIENCE, 85: 103, 1937.
[2] T. H. Mead, *Biochem. Jour.*, 33: 589, 1939.
[3] A. O. Tischer, *Jour. Biol. Chem.*, 125: 475, 1938.

more probable that the difference is due to a slightly different spectrophotometric technique and the use of different instruments.

Since the high-melting vitamin A alcohol and the crystalline palmitate present possibilities for biological research and the standardization of vitamin A preparations, it is important that their stability under various conditions be known. We have made preliminary storage tests on the palmitate, distilled esters from a fish-liver oil, vitamin A 2-naphthoate (kindly supplied by Dr. T. H. Mead) and beta carotene, the present international standard, and found that they are equally stable in refined cottonseed oil at comparable concentrations when exposed to air in the dark. The crystalline vitamin A palmitate decays more rapidly than the naphthoate on exposure to air. It is hoped to make a further report on the stability of these materials.

A preliminary biological assay of the crystalline vitamin A alcohol has shown that its potency is greater than 2,700,000 U.S.P. units per gram. It is planned to determine the biological potency of both crystalline vitamin A alcohol and crystalline vitamin A palmitate as precisely as possible. The results will be reported separately.

J. G. BAXTER
C. D. ROBESON

DISTILLATION PRODUCTS, INC.,
ROCHESTER, N. Y.

THE EFFECT OF SALICYLATE ON THE OXYGEN UPTAKE OF THE TUBERCLE BACILLUS

UNLIKE most other bacteria the tubercle bacillus does not readily oxidize carbohydrates, amino acids, hydroxy acids, etc., when these substances are added to suspensions in the Warburg apparatus. As shown in Fig. 1, the addition of 1.0 mg of sodium salicylate (o-hydroxybenzoate) to the bacteria suspended in 2.0 cc of M/20 phosphate buffer pH 6.7 more than doubles the oxygen uptake. A corresponding increase in CO_2 production also occurs. The bovine strain B_1 was used. It was grown on beef glycerine infusion broth and the floating masses were removed with a loop and suspended in sterile saline in Hopkins tubes. These were then centrifuged at 2,000 r.p.m. for 15 minutes and the saline replaced by sterile buffer, so that 0.1–0.2 cc of the packed bacteria were suspended in 1.0 cc of buffer. A glass rod the diameter of which was just smaller than the narrow part of the Hopkins tube broke up the cell masses and gave an even suspension. Fig. 1 shows that benzoate also has an effect on the oxygen uptake. On the other hand, p- and m-hydroxybenzoates and methyl salicylate are without action, as is acetylsalicylate until the acetyl group has been hydrolyzed off. p-aminobenzoate has no action and

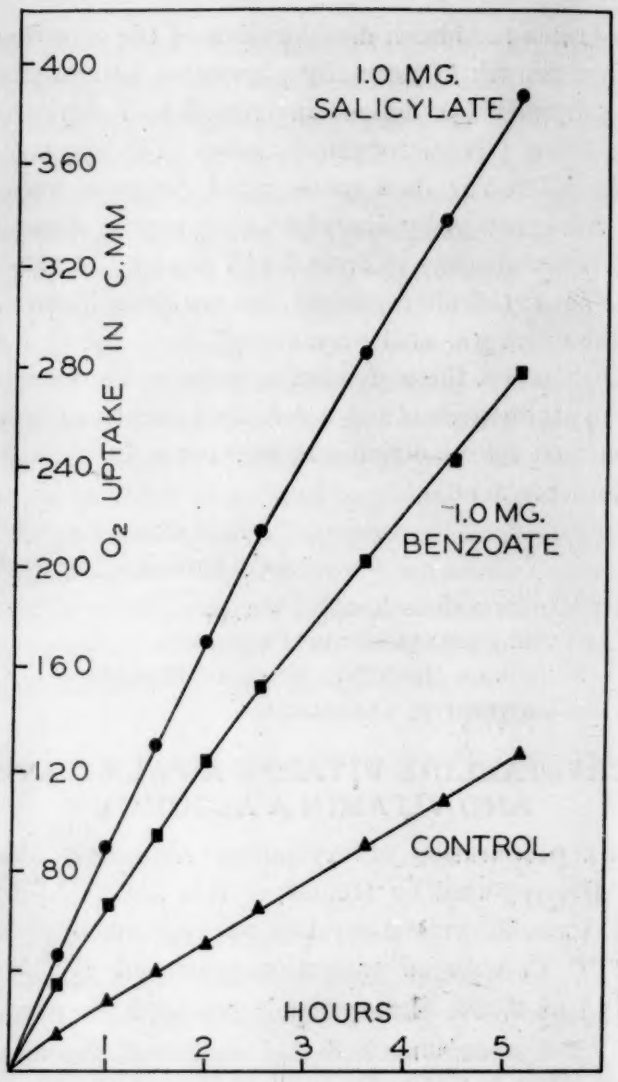

FIG. 1. The oxygen uptake of 0.5 cc of the suspension of tubercle bacilli alone and with salicylate and benzoate at pH 6.7 and 37° C.

o-aminobenzoate only a slight one, but when the latter is added with salicylate it inhibits the salicylate effect. o-aminosulfonic acids have not yet been tried.

When 0.1–0.2 mg of salicylate is used the oxygen uptake is proportional to the concentration, indicating that the salicylate is being oxidized as a substrate. No definite end-points were obtained. The results do not prove that salicylate is a normal metabolite of the tubercle bacillus but suggest that it or compounds of similar configuration may be important. The fact that p-aminobenzoate has been shown to be a metabolite of certain streptococci[1] indicates that substituted benzoates may play a part in bacterial metabolism.

FREDERICK BERNHEIM
DUKE UNIVERSITY MEDICAL SCHOOL

NORNICOTINE AS THE PREDOMINATING ALKALOID IN CERTAIN TOBACCOS

NICOTINE has long been considered the main alkaloid of *Nicotiana tabacum,* ordinary tobacco. This view is based upon the finding of Pictet and Rotschy,[1] in 1901, that only 2.5 per cent. of the total tobacco

[1] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.
[1] Amé Pictet and A. Rotschy, [Paris] *Acad. des Sci. Compt. Rend.*, 132, 971–2, 1901.

alkaloids was other than nicotine. For the tobacco of their time, and for most commercial tobaccos of to-day, this percentage can probably be accepted as typical.

In recent years, however, tobacco breeders have been cultivating low-nicotine strains in an effort to produce milder smoking tobacco. From one such experimental lot of Maryland tobacco there has been isolated, in amount equal to 95 per cent. of the total alkaloids, a base identified as nornicotine. This base had previously been found in tobacco as a minor alkaloid constituent, and it had also been found in other species of *Nicotiana* as the main alkaloid. For example, C. R. Smith[2] found that it constituted about 95 per cent. of the alkaloids of *N. sylvestris*. The occurrence of nornicotine as the predominating alkaloid of *N. tabacum* appears to be a hitherto unrecognized fact. Whether there is an association between low-nicotine strains and nornicotine can not be definitely asserted, but there is some reason for believing that nature compensates for the repression of nicotine by synthesizing the closely related parent alkaloid.

Not only structurally, but also pharmacologically, the two are similar. As a contact insecticide against the bean aphid (*Aphis rumicis* L.), dl-nornicotine was more toxic than dl-nicotine, and about as toxic as l-nicotine.[3] The naturally occurring forms are laevorotatory in both cases, but no insecticide tests with l-nornicotine are known, probably because of its scarcity. Against animals the action of nornicotine was weaker, in one case being only one tenth that of nicotine.[4] From the smoker's standpoint this is fortunate.

The possibilities of nornicotine as a stomach poison against insects have not been explored, chiefly because of its unavailability. Now that the existence of a strain of tobacco containing it has been discovered, it is hoped to prepare a supply of this alkaloid for such tests.

L. N. MARKWOOD

BUREAU OF ENTOMOLOGY AND
PLANT QUARANTINE,
U. S. DEPARTMENT OF AGRICULTURE

SCIENTIFIC APPARATUS AND LABORATORY METHODS

TATOO PUNCH FOR NUMBERING RATS

PERSONS handling large experimental colonies of pedigreed albino rats usually invent some personal system of hole-punching or edge-snipping of their rats' ears, which symbols plus sex and cage number may be referred to a ledger to identify the specimens.

But tame albino rats usually face out and become both quiet and inquisitive as one approaches their cage. Making use of this inborn trait, a great deal of time and effort can be saved if one is able to read the individual ledger number of each rat directly in his ears at a glance without even opening the cage door.

In order to be able to do just this, some technicians spend much time in laboriously tatooing the ears of all their rats by means of a needle and India ink. At least 15 minutes is spent on each animal at the time of weaning. This procedure solves the problem admirably, but it is too wasteful of time.

We report here the construction of a handy tatooing punch for rats, which we have tested and found to be satisfactory. It consists of a base plate of sheet metal, $1'' \times 5\frac{1}{2}''$ in dimensions, serrated with 10 teeth on one side and hinged on the other side.

Ten small number plates ($\frac{1}{2}'' \times 1''$) are hinged to the base plate in parallel, as shown in Fig. 1. The number plates are normally held away from the base plate by means of small coil springs. On the serrations of the base plate (Fig. 2) are thin rubber pads. On the inside of the number plates opposite the rubber pads

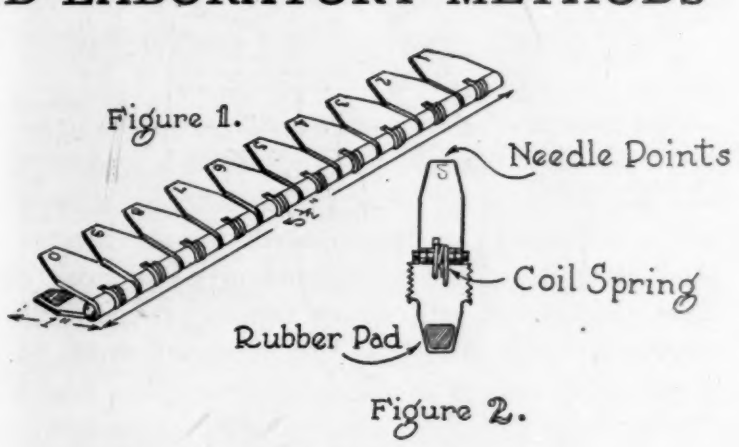

Figure 2.

FIGS. 1 and 2.

are soldered fine needle points so arranged as to outline numerals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0.

In tatooing rats' ears, one must be sure that the needles go clear through the pinna, and it is well to brush India ink into the holes on both sides to insure the best results. The rubber pad that receives the needle points insures that they pass completely through the ear.

Thus, to employ the tatoo punch properly the operator takes the punch in his right hand, inks the number desired by means of a stubby watercolor paint brush, grasps in his left hand the rat to be numbered, and with the index finger and thumb of the right hand closes the appropriate numeral plate firmly on the rat's ear

[2] C. R. Smith, *Jour. Econ. Ent.*, 30: 724–727, 1937.

[3] C. H. Richardson, L. C. Craig and T. R. Hansberry, *Jour. Econ. Ent.*, 29: 850–5, 1936.

[4] A. Bergwall, quoted by M. Ehrenstein, *Arch. der Pharm.*, 269: 627–59, 1931.

so that the inked needles pass through the ear and their tips penetrate the rubber pad. By releasing pressure the punch springs open. The operator then dabs the protruding needle points and removes the punch, at which time the needle points carry ink back into the holes as they are being withdrawn. Finally the operator brushes both sides of the ear vigorously in order to work the ink deeply into all the needle holes.

The chief difficulty encountered in preparing such a tatooing device is to have the needles fine enough and numerous enough that when a rat is tatooed at 3 weeks of age, the tatooed points will not separate enough to distort the numeral during subsequent growth of the pinna, because later the numbers increase about ⅓ both in length and breadth.

Likewise the numerals must be small enough that at least two of them may be placed side by side in each ear.

By using two numbers in each ear one may distinguish up to 10,000 individuals and by employing three numbers one may continue the series up to 1,000,000.

CLYDE E. KEELER

WISTAR INSTITUTE, PHILADELPHIA

A TESTED METHOD OF GROWING STENTOR COERULEUS

THE heterotrich protozoan *Stentor coeruleus* is valuable for many laboratory purposes but is difficult to maintain in culture. Several attempts were made to grow it according to methods described in the literature (Hetherington[1]; Turner,[2] Brandwein[2]), but none of these produced a satisfactory supply of specimens. Finally, a standard method was developed which has yielded specimens in abundance for more than a year. The method is described in the following paragraph:

Gallon jars are nearly filled with spring water, and to each is added 10 cc of an extract of lettuce, prepared by boiling 10 grams of fresh lettuce leaves in 100 cc of distilled water until about 50 cc has been evaporated. After 12 to 24 hours the water begins to appear cloudy due to bacteria. Then specimens of *Stentor coeruleus* and *Chilomonas paramecium* are put into the jars. Every few days, when the water shows signs of becoming clear, fresh lettuce extract is added. Whenever (usually two to four weeks) the stentors begin to multiply less rapidly, new cultures are started by transferring some stentors and chilomonads from the old cultures to jars of new medium. The jars are kept at room temperature in light of very low intensity or in darkness.

It is not known whether the stentors depend mainly for food upon the chilomonads or upon the bacteria. It is known, however, that the chilomonads are ingested readily. Rotifers which may be present in the cultures seem to cause no trouble, but paramecia must be kept out because they consume the bacteria so quickly that the stentors are deprived of their food supply.

The jars must be kept in light of low intensity or in darkness to prevent the excessive growth of unicellular green algae. Even in moderate light the algae gradually cause the culture medium to become green. If this condition is approached the stentors must be transferred to fresh medium.

No more than 10 cc of lettuce extract may be added to a jar at one time because an excess will cause bacteria and yeast cells to increase so much that the culture becomes too acid. The hydrogen-ion concentration of the cultures must remain between pH 6.2 and pH 7.8. These limits will ordinarily not be exceeded if the bacteria do not become too numerous.

Some difficulty may be experienced from the growth of aquatic fungi. The stentors tend to become entangled in the mycelia of these molds, making it difficult to remove them without injury. By stirring the cultures vigorously every few days, the mycelia are dislodged from the sides of the jars and settle to the bottom, where they cause no further trouble. If no lettuce infusion is added for some time, the stentors accumulate in the mats of mycelia on the bottom of the jars, but if more lettuce infusion is added they again collect near the surface of the water.

If it is desired simply to maintain a culture of stentors with a minimum of effort, fresh lettuce leaves may be put into the culture jars. But if this is done the stentors attach to the leaves. The advantage of using an extract of lettuce is that the stentors attach to the sides of the jars near the surface, whence they can be easily removed with a pipette.

W. H. BELDA
W. J. BOWEN

THE JOHNS HOPKINS UNIVERSITY

[1] A. Hetherington, *Archiv. für Protistk.*, 76: 118–129, 1932.

[2] J. P. Turner and P. Brandwein, "Culture Methods for Invertebrates," pp. 60 and 64. Ithaca, N. Y.: Comstock Publishing Company.

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